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ABSTRACT

Children's cognizance of linguistic selectional rules was studied in a controlled sentence production task. Forty-five third grade and 45 sixth grade children wrote noun responses in active and passive sentence frames in which only verbs and function words were given. The verbs varied in how animate nouns were required as both logical subjects and objects. It was found from measures of response animateness that the selectional rules were followed for both subjects and objects, and verb classes defined for both together. Animate responses were favored in the noun position before verbs, indicating the presence of a response bias. (Author/FWB)

SELECTIONAL RULES IN CHILDREN'S SENTENCE PRODUCTION

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The child learning language may be considered to acquire a generative system of rules formalized in the linguistic grammar of an "ideal" speaker-hearer (Chomsky, 1965; McNeill, 1966). While this grammar in some sense underlies his communicative use of language, the child's (and the adult's) speech production and perception may frequently be inadequate sources of information about his linguistic knowledge. For example, the derivational complexity of the grammar may be undercut by the use of immediate processing strategies in speaking and listening (Bever, 1970). Furthermore, mature language users both produce and understand utterances which are often awkward at best, but are nonetheless capable of making reliable judgments about the grammaticality of sentences (Downey & Hakes, 1968). While the ontogeny of the divergence of language behavior and linguistic intuition is not well understood, the limitations of relying on the former to describe grammatical knowledge should be apparent.

An assumption underlying the present investigation is that experimental techniques which more actively recruit the use of linguistic judgments are particularly necessary for the study of grammatical knowledge in children. In this research, children's understanding of restrictions English verbs place on the occurrence of nouns as their subjects and objects was explored

in a controlled sentence production task. The experimental method used was intended to permit asking a specific question about children's grammatical knowledge, while reducing and controlling for the influence of possible language processing strategies.

The linguistic cooccurrence rules which govern which nouns may be the subjects or objects of a verb (or, conversely, which verbs a noun may be the subject or object of) are called selectional restrictions. In recent linguistic descriptions of English (Chomsky, 1965; Lakoff, 1965; Wall, 1968), selectional rules apply to binary properties (or features) of nouns such as animate-inanimate and concrete-abstract. These properties are stated for verbs as contextual features. For a given noun and verb, these features must not be disjunct if the two items are to enter into a specific grammatical relation with each other. Subject and object are abstract noun functions in these relations at a linguistic level to be referred to as logical structure.

Selectional rules hold for these logical structure subjects and objects, which correspond roughly to the words which are the agent of the verb and receive its action. For example, the transitive verb "read" normally requires an animate subject but inanimate object. (Animate nouns can be defined here operationally as referring to people, animals, and groups of either.) These restrictions obtain no matter how the subject and object may be juxtaposed with the verb "read" in actual sentences, as in (1) a - (1) c.

(1) a It was the student who read the book.

b The one who read the formula was the engineer.

c The article was that the psychologist read.

When they are not observed, as in (2) a, where the logical subject of "read" is inanimate, (2) b, where its logical object is animate, or (2) c, where the feature for animateness is violated for both its subject and object functions, the resulting sentence in ungrammatical.

(2) a *It was the rock who read the book.

b *The one who read the cow was the engineer.

c *The cow was what the rock read.

(Notice that in the sentence "John reads Faulkner", the proper noun "Faulkner" is not an animate object, but refers to something (inanimate) that he wrote.)

The selectional restrictions on a verb's subject and object for animateness need not be mutually exclusive; they may be partially symmetrical, permitting some of the same nouns to occupy both functions, or may even be identical. While the present study was concerned specifically with the animateness of nouns as a feature selected by verbs, a noun must presumably have all of the abstract features a verb requires and none of those it excludes to serve as an appropriate subject or object.

One way of learning if children are intuitively aware of these abstract selectional rules is to have them fill subjects and objects in sentence frames containing different restrictions, and in which the superficial position of blank slots for nouns is not a reliable clue to their logical functions. To the extent that their responses then meet selectional rule constraints, it can be reasoned that Ss possess knowledge of the rules. At the same time, the controlled production approach may be helpful in specifying effects of possible speech processing biases that are associated with English word order. To the extent that Ss' responses deviate from one surface structure to anot :,

it can be reasoned that they were not employing abstract syntactic principles alone, but also were responding partly on the basis of preferences or habits characterising their normal language behavior.

In the present study, the position of logical structure subjects and objects relative to the verb was counterbalanced by having Ss complete both active and passive sentence frames containing only verbs and function words. (The active-passive difference reflects opposite orders of subject, verb and object.) Predictions based on selectional rules were tested from responses to both subject and object functions; the possibility of a response bias was evaluated by comparing active and passive frame responses to each other.

Method

Materials. The stimuli were active and passive sentence frames containing 36 English transitive verbs. The verbs employed influence the animateness of their subjects and objects differentially, so that six classes may be distinguished. The nature of the selectional rules forming the basis of the classification of verbs studied is shown in Figure 1. Verb classes in the

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Insert Figure 1 about here

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upper row of Figure 1 require animate nouns as subjects, while those in the lower row permit inanimate subjects. By convention, subject noun responses to members of classes in the two rows will be referred to as +AN and ±AN subjects. Similarly, verb classes in the left column of Figure 1 require animate

nouns as objects, while those in the middle column permit inanimate nouns as objects. Verb classes in the right column require inanimate nouns as objects. By convention, object noun responses to members of classes in the three columns will be referred to as +AN, ±AN, and -AN objects.

The actual verbs selected to intuitively meet these criteria as closely as possible were the following: Class I: marry, thank, command, hire, arrest, punish; Class II: kiss, want, love, attack, kick, steal; Class III: read, learn, sing, design, rent, repair; Class IV: fool, surprise, excite, entertain, scare, confuse; Class V: pull, lift, push, strike, transport, scratch; Class VI: make, open, break, bend, fasten, plow. Word frequency was varied for the verbs, as given in the Lorge magazine count (Thorndike & Lorge, 1944). Over all the classes, the average frequency of the first three verbs given was about 2000 each, while for the second three, it was about 200 each.

Active and passive sentence frames were constructed for all 36 verbs. The sentence frames for each verb looked like the following sample ones for the verb "marry":

The _____ married the _____.

The _____ was married by the _____.

No subject or object nouns were included in any of the sentence frames, and the two blank spaces were all of uniform length in all frames (20 typewritten spaces). The frames were printed six to a page and assembled in booklets. All pages included one verb from each verb class, with active and passive frames alternated every sentence, so that each booklet contained eighteen frames of each kind. All test booklets contained all 36 verbs; active and passive frames for each verb were counterbalanced across booklets.

Two practice items were printed on the front cover of each booklet.

Subjects. Forty-five third grade and 45 sixth grade pupils from a public elementary school in New York City were tested near the end of the school year. Although males and females were not evenly distributed in the two grades (there were more younger boys and older girls), the difference was not large enough to be significant, and the grades were not divided on the basis of sex in the results.

Procedure. Teachers in the school read instructions to their own pupils and supervised the experimental task. In the instructions, the children were asked to make up some sentences by filling in the blank spaces in some "incomplete" sentences. The only restrictions placed on their responses were that they print only one word in each blank space, and that the words they chose make sense with the other words in the sentence. Teachers demonstrated how to do the task by writing the two sample frames on the blackboard and showing how they might be completed. The children were then told to open their booklets and begin filling in the blank spaces. They were give ample time to complete the task.

Results

Each child made 72 responses, or two for each sentence frame in his booklet. All responses were scored as animate or inanimate by three adult observers following the operational definition of animate nouns given above. Agreement among observers was found to be almost always unanimous; the handful of ambiguous cases were agreed on in discussion. For each grade,

distributions of animate and inanimate responses and the proportion of animate responses in these distributions were then calculated for all four noun slots for all 36 verbs. These were the data subsequently analyzed to test hypotheses derived from the selectional rules, and for the possibility of a response bias.

Three major sets of findings reported below which were obtained from these measures were (a) the selectional rules were followed in all categories of subject and object responses; (b) the six classes of verbs were treated differentially as predicted from their combined selectional restrictions; (c) between sentence frames, animate responses were favored in the first noun position for both subjects and objects. Statistically significant developmental differences also reflected fewer selectional rule violations and the use of more permitted inanimate subjects by older children. Word frequency appeared to have no effect on response animateness in preliminary analyses of the data, and all results reported are for responses to appropriate high and low frequency items taken together.

Within-Grade Comparisons

On the basis of the selelctional rules for the sample of verbs employed, subject responses were predicted to be more animate overall than object responses. The proportion of subject responses which were animate was .89 for third graders and .85 for sixth graders. The respective proportions of animate objects were .54 and .53. For both grades, the hypothesis of greater response animateness for subjects was confirmed ($p < .001$ for each by chi-square tests). These differences were also strongly confirmed at both grade levels when tested for active and passive frames separately.

The selectional rules also predict that subject and object responses to some verbs will be more strongly animate than the corresponding responses to other verbs. Table 1 shows the proportion of animate subject and object

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Insert Table 1 about here

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responses for each grade and the restrictions on their selection. The differences which could be predicted between +AN and ±AN subjects, and between +AN and ±AN, and ±AN and −AN objects, were all found to be significant by verbs in both grades ($p < .001$ for each by one-tailed Mann-Whitney U tests). That is, subject responses to verbs falling in classes in the rows of Figure 1 were significantly different from each other as predicted, as were object responses to verbs falling in classes in adjacent columns. Separate additional analyses of active and passive frame responses again confirmed all of the differences initially found for combined frames.

Linguistic predictions of pairwise differences between verb classes in total animateness were generated by ranking classes for combined selectional restrictions on subjects and objects (i.e., for both functions together). The predicted order was based on the proportion of "+" signs in the row and column heads delimiting each verb class in Figure 1. The nonredundant predictions which could be made on this basis were the following (in descending order of animateness):

Class I > Classes II, IV > Classes III, V > Class VI

The proportions of animate responses for verb classes and grades are shown in Table 2. In each grade about 70% of all responses in both kinds

Insert Table 2 about here

of sentence frames were animate. All of the predicted differences between pairs of verb classes were confirmed for both grades well beyond the .01 level of significance by chi-square tests. When response distributions for the verb classes were analyzed for active and passive frames separately, again all the predicted differences were strongly confirmed at both grade levels.

The selectional rules for animateness make no predictions of differences between active and passive frame responses for subjects or for objects. In fact, all of the predicted differences found for combined frames were also confirmed for each frame separately. There was almost no difference in animateness between active and passive frames for all responses in each combined. However, systematic differences between frames were observed in the data for both subjects and objects separately. The respective proportions of animate responses for the two grades are shown in Table 3. In grade three,

Insert Table 3 about here

overall subjects were more animate in active frames than passive frames. On the other hand, overall objects were more animate in passive sentence frames than active ones ($p < .001$ for each by two-tailed Wilcoxon matched-pairs signed-ranks tests by verbs). The differences observed between frames were significant in the third grade for both $+$AN and $\pm$AN subjects, and for $\mp$AN and $-$AN objects, with a two-tailed probability level of less than .02

in all cases but one. Of these four differences, the first and last reflect more ungrammatical completions in the third grade's passive frame responses. In grade six, overall subjects were also more animate in actives than passives ($p \approx .01$ by two-tailed Wilcoxon test by verbs). However, the difference favoring animate objects in passives was not large enough to reach significance ($p > .09$ two-tailed). Of the five subcategories of subjects and objects, only $\pm$AN subjects were significantly more animate in sixth grade responses in one frame than the other ($p < .01$ two-tailed).

Between-Grade Comparisons

All of the differences predicted between verb classes and subjects and objects were confirmed at both grade levels. No difference obtained between grades on corresponding verb class distributions (e.g., Class I distributions) were significant by chi-square tests nor was the difference over all classes. However, for both combined frames and separate frames, a number of between-grade differences for both subjects and objects were consistent enough to reach significance.

Among these were three of five combined-frames comparisons within the response subcategories in Table 1. Sixth grade responses were found to be more animate than third grade for +AN subjects and +AN objects ($p \approx .02$ for each by two-tailed Wilcoxon tests by verbs). These two differences largely reflect the reduction of ungrammatical responses from 5% of those possible for animateness in grade three to 2.5% in grade six. Combined-frame sixth grade responses were also less animate than third grade for $\pm$AN subjects ($p < .01$ two-tailed). Separate-frame comparisons revealed that the +AN subject and +AN object differences were significant only in passive frames, while the $\pm$AN subject disparity was significant in both frames.

In general, the results of the present study establish that children 9-12 years of age know and can use in their sentence productions the linguistic constraints for animate and inanimate subjects and objects found in English verbs. The relatively small proportion of violations committed indicates that the animate-inanimate noun distinction was strongly marked as a property crucial to sentence construction. All pairwise differences which could be predicted from the selectional rules among categories of subjects, objects and verbs defined jointly were confirmed without exception. The conclusion of differentiated selectional rule knowledge in the children appears to be valid and even necessary to explain these results.

It is also reasonable to conclude that the children participating in the study were able to understand the logical relationship between active and passive sentences, and, in particular, the regular reversal of the logical functions of pre-verb and post-verb nouns as subjects and objects. This is supported by the fact that their intuitive knowledge was sufficiently abstract to be applied in both active and passive frames, in both of which all predicted differences were also confirmed separately. Thus, it appears that Ss were able to use an appropriate cognitive strategy most of the time. To do this, they would have needed to identify the logical function of a given noun slot independently of its position in the frame, as well as to know both the abstract constraints of particular verbs and the animateness property for nouns in their vocabulary.

While the evidence for these kinds of linguistic knowledge is compelling, it appears likely that the employment of sophisticated intiuitions about the verbs

and sentence frames was not exclusively responsible for the selection of nouns in the task. As noted previously, selectional rules such as those for animateness do not predict that noun features will vary for the same logical function in the surface grammatical structures of related sentences, such as actives and passives. This phenomenon, however, was observed at several different points in the present results. Animate nouns were favored in the position before verbs for both subjects and objects.

The tendency for noun responses to be more animate when preceding the verb may represent the influence of preferences or strategies used in speaking and listening. Bever (1970) has recently proposed that speech perception in the child and adult is largely dependent upon such strategies, and that these strategies are partly based on the relation of sequences of form classes in sentences to more abstract linguistic structures. For example, there is probably a fairly strong subject-before-verb regularity in English sentences. One language processing strategy grounded on this correspondence which Bever suggested is that any Noun-Verb-Noun (NVN) sequence will be interpreted perceptually as the actor, action and object in deeper logical and semantic structures. Children's difficulty with passive sentences can be interpreted as an instrance reflecting such a behavioral overgeneralization (Fraser, Bellugi & Brown, 1963; Bever, 1970).

The operation of a bias, as formalized in the NVN $\rightarrow$ actor-action-object strategy, may be reflected in the present study both by the asymmetrical occurrence of selectional rule violations in passive frames, and by the tendency for $\pm$AN subjects and objects to be more animate when they are the first noun in the sentence frame. Of all "error" responses (leaving completed

sentences ungrammatical in the adult language), over 42% resulted from making the first noun animate, and 28% more from making the second noun inanimate. In the theoretically unbiased ±AN conditions, 82% of subjects were animate in active frames, as opposed to 69% in passives; 65% of objects were animate in passives, as opposed to 50% in active frames. These latter differences are more consistent between grades and sentence frames than those for errors, with the only developmental trend in them being a symmetrical 10% decrease across frames in animateness of the ±AN subject function. Thus they may reflect the operation of a bias which continues (perhaps in a still more weakened form) on into the language behavior of the adult.

In this respect, it is of interest that Clark (1965) also reported a syntactic function by surface structure position interaction for animateness as a dependent variable, although only for the condition in his study in which older, high school age Ss filled in active and passive sentence frames completely filled-in sentence frames with the present results indicates that the order of animateness obtained was the same in both studies (active subjects, pssive subjects, passive objects, active objects). But subjects and objects were nevertheless 9-23% more animate in the present study than in Clark's. This general tendency might reflect a trend toward less frequent use of animate nouns with increased age, but it is also possible that it is due to the freer choice of lexical items (without previous contextual constraints) in Clark's task, and the left-to-right constraints in production which that choice seems to imply.

The Ss in the present study may have preferred to follow the NVN schema proposed by Bever, and, in following it, to use animate nouns as pre-verb "actors" and inanimate nouns as post-verb "objects", the tendency observed for both noun positions by Clark. It is likely that some ungrammatical responses obtained represent an interaction of selectional rule and active-passive knowledge with such a response bias, and that some responses to items with ambiguous restrictions are also a function of the preference to choose animate nouns for the position before the verb, and inanimate nouns for the position after it. However, Ss clearly could not have used this strategy dominantly, since about one half of their sentence productions would have been ungrammatical as a result. This hypothetical fraction would require about 25 times the number of deviant sentences actually observed. It is therefore necessary to conclude that the results are mainly a function of selectional rule and active-passive knowledge, or of some heuristic procedure based on such knowledge.

It is possible to argue that selectional rules are also employed in ordinary language processing situations. In several studies of children's language comprehension and production (Slobin, 1922; Turner & Rommetveit, 1967; Hayhurst, 1967), selectional rule constraints were the principal linguistic basis for constructing stimulus sentences varying in "reversibility". (The subject and object nouns of a reversible sentence could be interchanged [occupy the opposite function] without it becoming semantically anomalous; nonreversible sentences could not undergo this transition and remain grammatical.) As employed in these studies, however, reversible sentences contained verbs with generally weaker selectional rules on animateness than nonreversible sentences, in which the rules usually precluded noun reversal. Only for reversible sentences was it found that it was much more difficult

for children to establish an appropriate correspondence between a sentence and a situation shown in a picture (e.g. to produce the sentence).

The present results lend some support to a selectional rule-based interpretation of these general findings for sentence reversibility. In principle, Ss of the same age as those in the present study should have had similar linguistic knowledge. In their performance on the picture identification tasks, they may have actually utilized the selectional rules known to them. It is possible that the general psychological effect of more divergent (largely nonoverlapping or mutually exclusive) restrictions is to reduce the number of potential structural interpretations a language user normally calculates for any sequence containing nouns and verbs. Fodor , Garret and Bever (1968) have suggested that a verb's potential to take object complement structures can be used to predict Ss's relative difficulty in manipulating word sequences which contain it. The effect of verb structure in the selectional rule sense on processing difficulty may be an analogous case; the presence of a verb capable of entering into different syntactic relations with the same kinds of nouns may complicate the functional interpretation of actually cooccurring ones. While divergent rules could simplify making this decision, ambiguous restrictions would leave open the assignment of functional relations to other structural cues. The acquisition of actively employable selectional rules should then be marked by the differentiation of nonreversible from reversible sentences. As children grow older, the subject-object confusion explained by NVN - actor-action-object appears in fact to be largely limited to reversible sentences; for nonreversible sentences, the difficulty is largely curtailed.

In conclusion, it is felt that the technique employed offers promise of a controlled exploration of grammatical knowledge in children not captured by previous observations from spontaneous speech, or experimentation implicitly encouraging the direct use of behavioral biases. Whether it is possible to collect data on children's linguistic competence which is completely unaffected by strategies for perceiving and producing the linguistic code is still an open question. Results from the present study, however, can be interpreted to be partially a function of possible language processing factors.

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Footnote

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Table 1

Proportion of Animate Subject and Object Responses by Selectional Rules and Grades.

Grade	Subject				
	+AN	± AN	+AN	± AN	-AN
Third	.98	.80	.95	.57	.09
Sixth	.99	.71	.98	.56	.06

Table 2

Proportion of Animate Responses by Verb Classes and Grades.

Grade	Verb Class					
	I	II	III	IV	V	VI
Third	.98	.81	.55	.88	.60	.45
Sixth	.98	.85	.53	.85	.54	.71

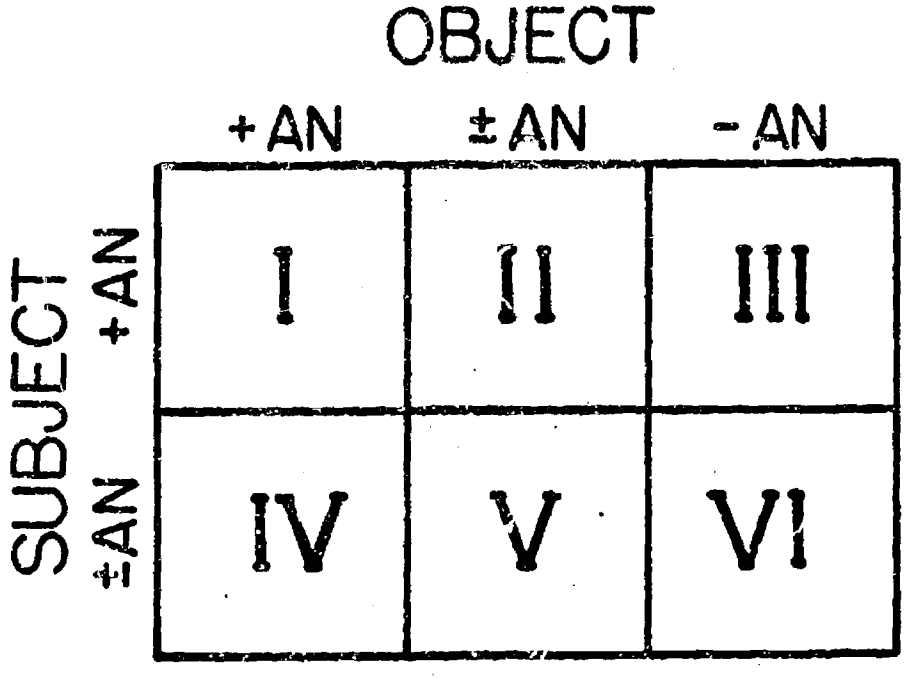
Table 3

Proportion of Animate Subject and Object Responses by Sentence Frames and Grades.

Grades	Subject		Object	
	Active	Passive	Active	Passive
Third	.93	.84	.49	.59
Sixth	.88	.83	.50	.56

Figure Caption.

Figure 1. Selectional rules on animateness for six classes of verbs.


OBJECT
+AN
±AN
-AN
SUBJECT
+AN
±AN
I
II
III
IV
V
VI